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## **THE EXTERNAL FIXATOR FOR THE ACETABULUM**

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***Abstract:** The Traumatology Centre of the Teaching Hospital with the Outpatient Clinic in Ostrava-Poruba has been concerned with various aspects of healing unstable fractures by means of external fixators for a long time. It co-operates with the Department of Production Machines and Design of VŠB – Technical University of Ostrava in the study, development and production of external fixators. Recently an external fixator for the acetabulum has been developed, produced and experimentally verified at both the workplaces.*

**Key words:** acetabulum fracture (pelvic fracture), external fixator for the pelvis, biomechanics, os, fixator suspension, suspension deformation, verification on the cavader, evaluation

### **Introduction**

The Department of Production Machines and Design co-operates in the development of external fixators for healing unstable fractures with the Traumatology Centre of the Teaching Hospital with the Outpatient Clinic in Ostrava-Poruba.

The healing of fractures of the unstable type is still an open question of accident surgery. One of healing methods is the reduction and stabilization of the fracture by the external fixator.

Lately a prototype of the external fixator for the acetabulum has been developed, produced and experimentally tested at the workplaces. The external fixator serves the reduction and fixation of the pelvic fracture. With the external fixator that is connected to the suspension, the tension force in the range from 0 to 100 N can be continuously induced. Deformation of the suspension was experimentally verified. On the cavader a function of the fixator, including the suspension, was experimentally tested.

### **1 The external fixator for the acetabulum**

At the Department of Production Machines and Design, a prototype of the external fixator for the pelvis was designed. The function of the fixator serving the reduction and

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fixation of the fracture consists in inserting a screw (Schanz wire) into the hip joint. The external fixator is put on and firmly attached to this screw. The external fixator is then connected with the suspension placed into the ala ossis ilium. A view of the individual external fixator is presented in Fig. 1, a view of the fixator with the suspension is shown in Fig. 2. The fixator contains a calibrated spring (0-100 N) and an indicating device with a scale. By means of a screw and a nut, the required tension force with the maximum of 100 N can be developed.



Fig. 1 A view of the individual external fixator for the acetabulum



Fig. 2 A view of the external fixator for the acetabulum with the suspension

## 2 The measurement of rigidity of the suspension of the fixator for the acetabulum

Before the first verification tests of the fixator for the pelvis (Figs. 1, 2), it was necessary to verify deformation (rigidity) of the fixator suspension.

### 2.1 The principle of measurement

A photo from the measurement is presented in Fig. 3. The fixator suspension was by means of four screws (Schanz screws) fixed to the small wood-block, which should have simulated the suspension attachment to the sound part of the pelvis. To the suspension, the prototype of the fixator was attached with the screw that was intended for pulling the hip joint outwards. To this screw, a wire line was connected that was fastened to the stable part of the measuring device.

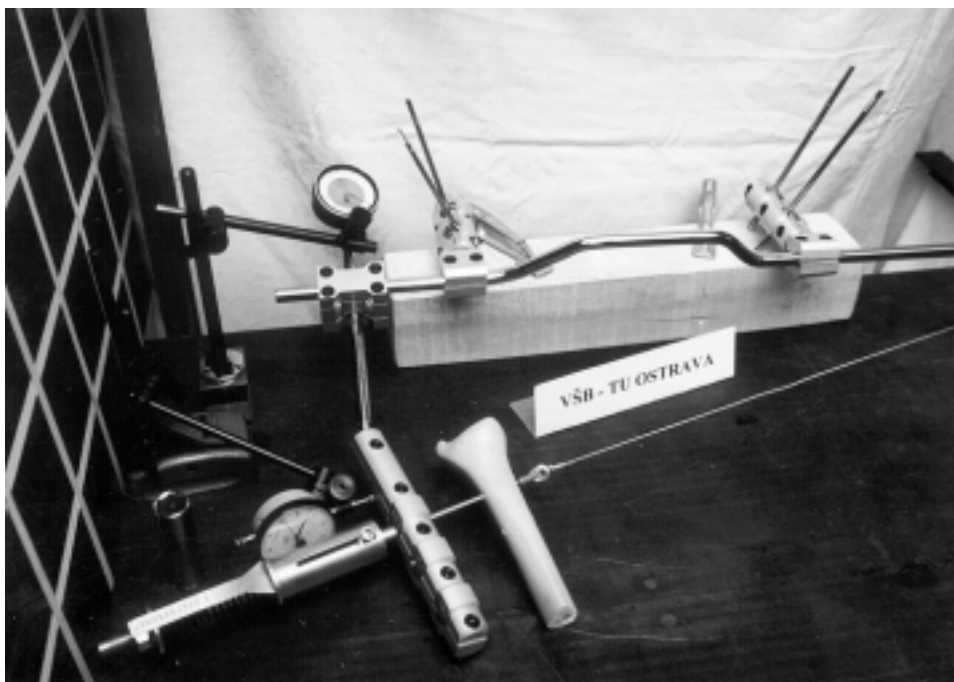


Fig. 3 The measurement of rigidity of the suspension of the fixator for the pelvis

By means of the pressure spring of the fixator, the load tension force in the screw (wire line) of 0-100 N was built up. Deformation of the fixator suspension was measured in two points, namely point **A** and point **B** as illustrated in Fig. 4. Deformation of the suspension was sensed by means of the indicating timepiece. The load tension force was gradually developed at the increases of 10N.

### 2.2 The evaluation of measurement

In the graphs in Figs. 5 and 6 values of deformation of the suspension of the external fixator for the pelvis in points **A** and **B** are plotted depending upon the load force **F**. When measuring under conditions approximating to almost clinical conditions, the maximum deformation at the maximum load force **F** = 100 N in point **A** was 5.666 mm, which had no effect on healing. It was also found that no subsequent permanent deformation of the fixator suspension occurred.

### 3 The verification of the prototype of the external fixator for the pelvis on the cavader

The fixator suspension (frame), including the prototype of the fixator was applied to a pelvis of a dead 47 years old man having a comminuted pelvic fracture (acetabulum) and the central dislocation of the acetabulum – see Fig. 7.

On the cavader, assumptions of the applications of the external fixator to acetabulum fractures were fully verified. Reduction possibilities of the fixator with various types of fractures were verified. After these experimental tests the introduction of the external fixator for the acetabulum into practice was suggested.

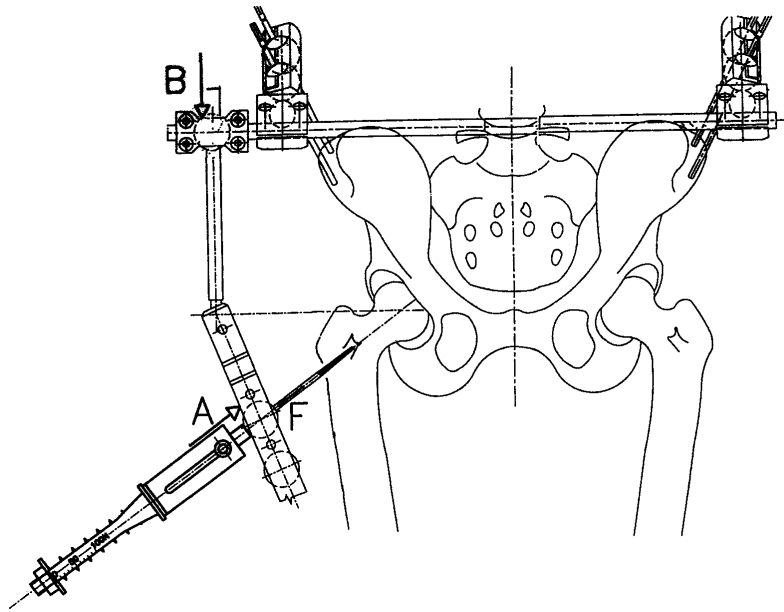


Fig. 4 The external fixator for the acetabulum

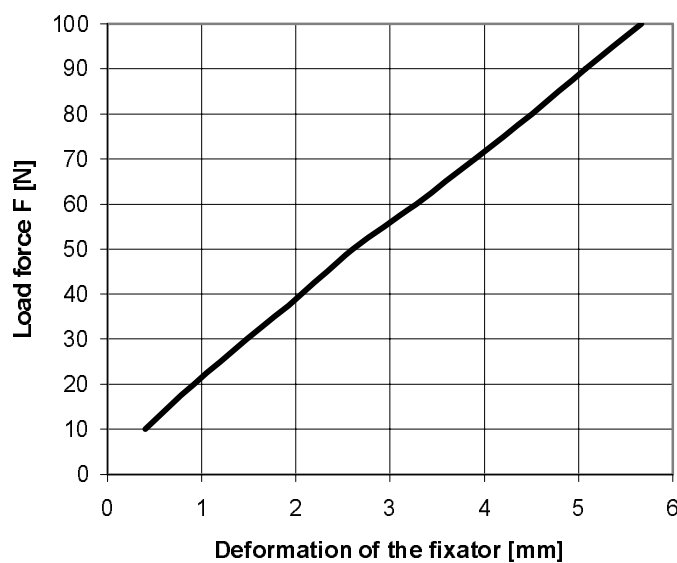


Fig. 5 Deformation of the suspension of the external fixator for the pelvis in point A depending upon the load force F

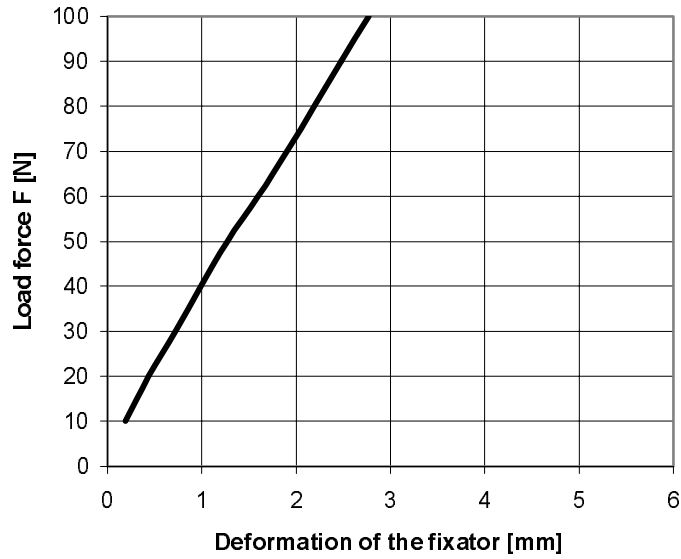


Fig. 6 Deformation of the suspension of the fixator for the pelvis in point **B** depending upon the load force **F**

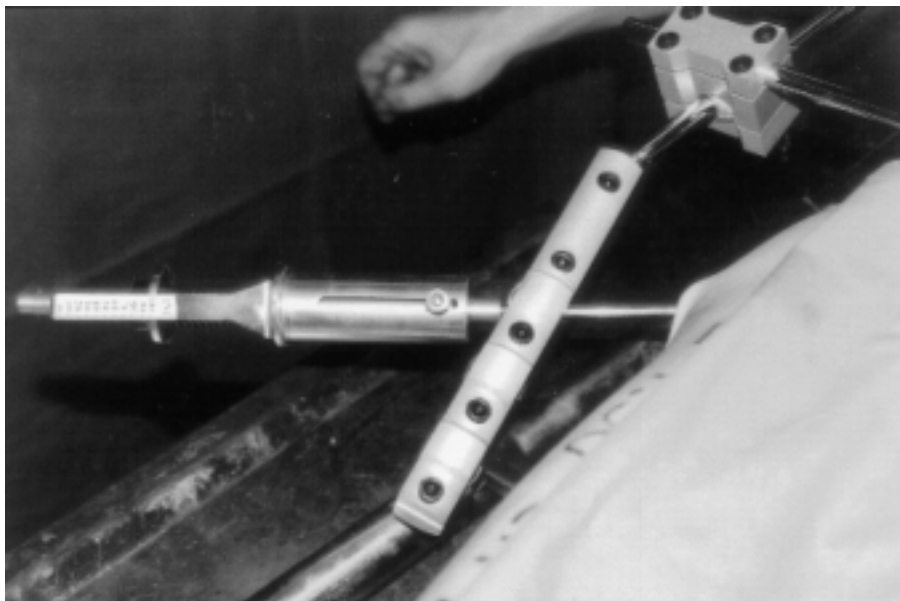


Fig. 7 The verification of the prototype of the external fixator for the pelvis on the caveder

#### 4 Conclusion

A prototype of an external fixator for healing fractures of the acetabulum with polytraumata was designed and produced. By measurement, the rigidity of the fixator suspension and the fixator function were verified on the caveder.

The measurement of rigidity of the fixator suspension proved its sufficient rigidity; tests of the fixator on the caveder showed its good function.

The external fixator for the acetabulum will be clinically verified at an early date.

The external fixator for the acetabulum was designed, produced and tested in the framework of solving the Research Project CEZ: J17/98:272300011, stage E06 "Modelling

the biomechanics of external fixators by using the physical model with the aim to improve their structure and to put forward new principles of their design” and the national research task IGA MZ ČR reg. No. 3522-4.

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